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Research Productivity in the Departments of Chemistry and Physics of The University of Burdwan during 1960 – 2000: A Comparative Study.

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Abstract

During 1960-2000, Chemistry and Physics department of the University of Burdwan, produced 141 awarded Chemistry theses, 979 published Chemistry thesis articles and 67 awarded Physics theses, 610 published Physics thesis articles. To compare the year wise productivity, authorship pattern and collaboration, Co-authorship pattern, Impact of authors, the citation scenario of the outstanding authors and ranked list of journals they have been analysed. The highest number of thesis (30) during 1986-1990 & 1991-1995 and the highest number of thesis articles (283) during 1991-1995 was submitted by the Chemistry Department whereas Physics department submitted highest number of theses (19) and highest number of thesis articles (158) during 1986-1990. The highest degree of collaboration is found in Physics Department (0.73) followed by Chemistry Department (0.70). Considering the name of the first authors only, the most prolific author were B.N Biswas (Physics) who topped the list with 108 papers followed by G.C Bhar (Physics) with 94 publications, A.K Das (Chemistry). The most credited author (considering fractional credit of authorship at any authorship position)was A.K Das (Chemistry Department) who topped the list with 84.7502 points, followed by B.N Biswas (Physics Department). The author with highest impact (according to 1st author) was G.C Bhar (Physics Department) who topped the list with 113.87 points, followed by A.K Das (Chemistry Department)with 45.82 points. The author with highest impact (considering all authors at any authorship position with shared credit) was G.C Bhar (Physics Department) who topped the list with 75.5825 points, followed by K Bhattacharya (Chemistry Department) with 36.6250 points. B.K Ghosh (Chemistry Department) received highest number of citations (662), whereas G.C Bhar (Physics Department) received 292 citations during this period. The leading journals preferred by the researchers of Chemistry departments are Ind Jl Chem with 185 papers and Ind Jl Pure Appl Phy with 47 papers by the researchers of Physics department. Taking all the papers of the two Departments together 692(43.54%) articles are published in Indian journals and 897 (56.46%) papers are published in foreign journals.

Keywords

Authorship collaboration; Authorship pattern; Bibliometrics; Chemistry; Citation Analysis; Dissertation; Journal Preference; Physics; R&D *organizations; Research; Productivity; Scientometrics; University of Burdwan.*

Introduction

Research and development has been one of the most significant areas of development of society throughout its entire existence. India invests a huge amount of money and time for the activities of higher education network and in the research and development infrastructure of the Universities. The independent evaluation of the research, development and innovation activities (RDI) in India is still in the process of finding. Now it is the right time to evaluate the objectives and operational processes of those activities. The evaluation of these activities is an important part to create a vision of the future opportunities of the institution as a part of the realm of research and development in India.

It is very important for their ranking, proper funding, grant releasing etc. Very few studies have been made to compare and evaluate the research output of the Universities and R&D organizations of West Bengal. In recent past NAAC started evaluation of overall activities of the universities of our country. In a 5 to 1 star ranking by NAAC, The University of Burdwan received four-star status, which is later revised to B+. The University of Burdwan was established in 1960 as a rural base university. Since then it has made a considerable contribution in the field of Pure sciences research. However, no specific effort has been made to evaluate the research contributions of the university. In the present work an attempt is be made to study the comparative research performance of Chemistry and Physics department of The University of Burdwan by analysing the awarded theses and related published literature outputs.

Literature Review

A number of scientometric analyses have been carried out during the last two decades to evaluate the research productivity of Indian scientists. In a study of the literature use pattern by the researchers in the field of Chemistry: Gross and Gross (1927) performed a citation based related study. They identified the chemistry periodicals that best served a small college library. Librarians all over the world have used this method to improve their collection

Anand (1979) measures the cost efficiency of journals subscribed to by Indian scientific institutions; and to determine the use of journals in languages other than English. Of the 12,000 chemical journals published throughout the world in the year in question, only 408 were cited in the Journal of the Indian Chemical Society. Controlling the importation of little cited journals would lead to foreign exchange savings.

Guay (1986) performed a quantitative survey of the emergence of organic chemistry in India during the first two decades covered by Chemical Abstracts. He found that chemists who were conducting research in India were separated in three distinct groups. Identified important disparities between these three groups both in terms of research fields and in terms of publication outlets, on the basis of their cultural identity and educational background

Mubeen (1996) reports the results of a citation analysis of 22 PhD theses in chemistry submitted to Mangalore University, India, since its inception. The study identified 60 core periodicals, out of a total 418. The application of Bradford's Law of Scatter reveals an exponential trend and the Bradford multiplier is seen to observe a geometric series pattern.

Karki and Garg (1999) use the scientometric techniques to assess the performance of Indian organic chemistry research during the 70s and 80s. They observed that the organic chemistry research performed in India during the later period (80s) has improved slightly as compared to the previous period (70s).

In a study of the literature use pattern by the researchers in the field of Physics: there are so many citation analysis in Physics have been carried out by the different time period e.g. Fussler (1949), Louttit (1957), Gupta (1994),Dhawan and Yadav (1972), Sandison (1974), Singleton (1976), Rangarajan and Gupta (1979), Kapoor (1980), Sangam and Nargand (1997), Sudhier (2007) etc.

Garg and Rao (1988) analyses the output of the publication data of an Indian laboratory in the field of physics in science citation index (SCI) and non SCI covered Indian and foreign journals, processes developed and Indian patents filed during the period 1965-82 to find out the pattern of productivity. Also they found out the journals wherein the laboratory scientists publish, the sub-areas of physics in which the laboratory scientists have published maximum papers and the pattern of scientific co-authorship in the research work. They calculated correlation coefficients between input variable with output variables.

Garg K C and Padhi P (2002) studied the scientometrics of laser research in India during 1970-1994. During the analysis of 952 publications published by Indian scientists and abstracted by Journal of Current Laser Abstracts during 1970-1994 they found that laser research in India picked up during 1978-1994 and reached its peak in 1980.

Gupta and Dhawan (2007) analysed the present status of Indian physics, particularly with regard to the nature of research system, nature of institutions involved, type of education available and outturn at postgraduate and PhD level. They revealed the growth of Indian physics output, as reflected in mainstream international journals covered in Expanded Science Citation Index (Web of Science) during 1993-01. Discussed the various features of Indian physics research output, such as growth, institutional publication productivity, nature of collaboration, and the quality and impact of its research output.

Objectives

The objectives of the present study are:

1. To analyse and compare the trend of doctoral research in Chemistry and Physics department in The University of Burdwan during 1960-2000.
2. To find out and compare year wise publication productivity in Chemistry and Physics department.
3. To study and compare the pattern of authorship collaboration in Chemistry and Physics department.
4. To identify and compare the most prolific authors of the Chemistry and Physics department with their credit and Impact.
5. The citation scenario of the outstanding authors of Chemistry and Physics department.

6. To identify and compare the journal preference of the researchers in which they have communicated their research findings.
7. To find out the country wise distribution of journals.

Methodology

There were 141 no. of Chemistry and 67 no. of Physics doctoral dissertations awarded from the department of Chemistry and Physics of this University from 1960 to 2000. The published articles appended in these theses and the articles reported in the Annual Reports of the University were taken as the input for the study.

All the bibliographic details of those theses and related articles were noted on separate 8 X 5 inches slips. A computerized database is then created for in-depth analysis.

Analysis

Year-wise distribution of theses over a five year grouping in Chemistry and Physics

The year wise thesis submission over a five-year grouping is shown in Table 1. During the time span 1986-1990 the highest 19 number theses were submitted in Physics during 1986-1990 and 1991-1995 the highest 30 numbers of theses were submitted in Chemistry.

Table – 1
Year-Wise Distribution of Theses over a five-year grouping in Chemistry and Physics

Year	No. of Theses in Chemistry	No. of Theses in Physics
1960-65	0	0
1966-70	5	02
1971-75	11	02
1976-80	17	10
1981-85	26	09
1986-90	30	19
1991-95	30	14
1996-2000	22	11
Total	**141**	**67**

Guide rank in Chemistry and Physics during 1960-2000.

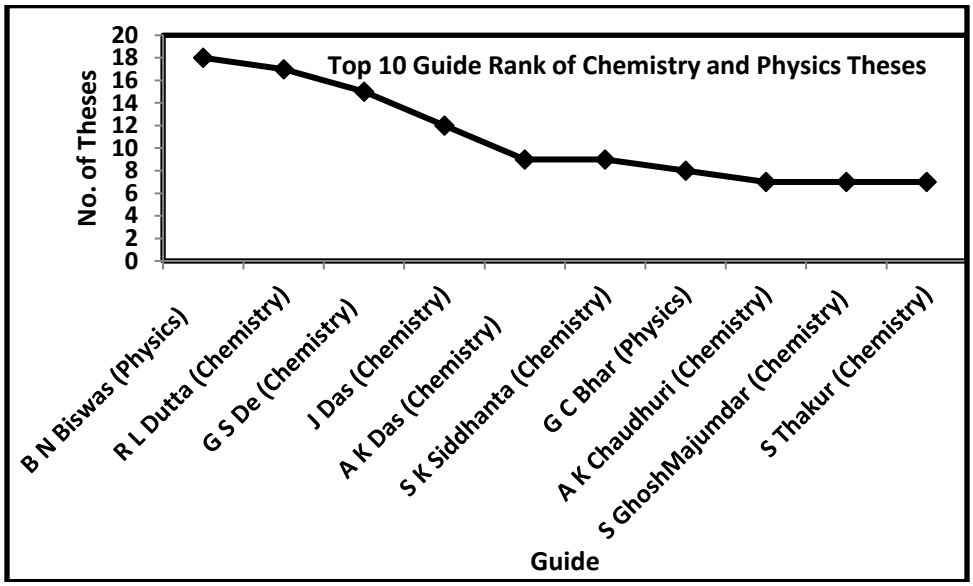
A ranked list of the guides of the Chemistry and Physics departments of this university is shown in Table – 2. Baidya Nath Biswas (Physics Department) who topped the list with 18 theses, followed by Rabindra Lal Dutta (Chemistry Department) with 17 theses, Gouri Sankar De (Chemistry Department)with 15 theses and Jyotirmoy Das (Chemistry Department) with 18 theses. It is evident that the guides of the Physics department have guided the highest number of theses compare to Chemistry department. Fig – 1 represents the top 10 credited authors.

Table - 2
Guide Ranks of Chemistry and Physics Theses.

Sl. No	Rank No	Author Name	No. of Theses	Department
1	1	Baidya Nath Biswas	18	Physics
2	2	Rabindra Lal Dutta	17	Chemistry
3	3	Gouri Sankar De	15	Chemistry
4	4	Jyotirmoy Das	12	Chemistry
5	5	Arabinda Kumar Das	9	Chemistry
6	5	Sushil Kumar Siddhanta	9	Chemistry
7	6	Gopal Chandra Bhar	8	Physics
8	7	Ajay Kumar Chaudhuri	7	Chemistry
9	7	Subhendu GhoshMajumdar	7	Chemistry
10	7	Swapnadip Thakur	7	Chemistry
11	8	Dhiraj Neogi	6	Physics
12	8	Ranjit Sinha Konar	6	Chemistry
13	8	Sukalyan Basu	6	Chemistry
14	9	Sisir Chandra Rakshit	5	Chemistry
15	9	Suchit Ch. Chakraborty	5	Physics
16	10	Anath Jiban Bhattacharya	4	Chemistry
17	10	Bejoy Kumar Seal	4	Chemistry
18	10	Bhupal Ch. Samanta	4	Physics
19	10	Sanjib Bagchi	4	Chemistry
20	10	Satyendra Nath Banerjee	4	Chemistry
21	10	Sriranjan Banerjee	4	Physics
22	10	Tapan Kumar Das	4	Physics
23	11	Arun Sankar Basu	3	Chemistry
24	11	Barindra Kumar Ghosh	3	Chemistry
25	11	Bishnucharan Sarkar	3	Physics
26	11	Nori Kurmaiah	3	Chemistry
27	11	Pranab Kumar Sengupta	3	Physics
28	11	R.K. Ghatuary	3	Chemistry
29	12	Ashok Kumar Mukherjee	2	Chemistry
30	12	Ashutosh Mookherji	2	Physics
31	12	Independently	2	Physics
32	12	Kamal Bhattacharyya	2	Chemistry
33	12	Mriganka Sekhar Sinha	2	Physics
34	12	Sudeb Sankar Dasgupta	2	Physics
35	12	Sushanta Kumar Lahiri	2	Chemistry
36	13	A.K.Chakraborty	1	Chemistry
37	13	Chittaranjan Sinha	1	Chemistry
38	13	Dilip Sen	1	Physics
39	13	Dipak Kumar Pal	1	Chemistry
40	13	Gopal Chandra Bhowmik	1	Chemistry
41	13	Kalicharan Das	1	Physics
42	13	Manas Banerjee	1	Chemistry
43	13	Pradyot Ghosal	1	Chemistry
44	13	Ranendra Kumar Roy	1	Physics

45	13	S.K. Chatterjee	1	Physics
46	13	Subrata Laskar	1	Chemistry

Fig. – 1
Top 10 Guide Ranks of Chemistry and Physics Theses



Year wise distribution of articles over a five-year grouping in Chemistry and Physics.

The article submission over a five-year grouping is shown in Table - 3. During the time period of 1991 to 1995, 1986-90 and 1996-2000 maximum number (283, 219 and 214 respectively) of articles were published from Chemistry department followed by 158 articles from Physics department during 1986 to 1990. Chemistry department has produced highest number of articles compare to that of Physics department.

Table - 3
Year Wise Distribution of Articles over a five-year grouping in Chemistry and Physics.

Year	No. of Articles	Department	Department
1991-95	283	Chemistry	
1986-90	219	Chemistry	
1996-2000	214	Chemistry	
1986-90	158		Physics
1991-95	131		Physics
1976-80	128		Physics
1976-80	113	Chemistry	
1996-2000	86		Physics
1981-85	83	Chemistry	
1981-85	48		Physics
1971-75	39	Chemistry	
1971-75	39		Physics

1966-70	24	Chemistry	
1966-70	14		Physics
1960-65	6		Physics
1960-65	4	Chemistry	
TOTAL	**1589**	**979**	**610**

Degree of Collaboration of thesis articles in Chemistry and Physics.

Degree of collaboration among co-authors:- The degree of collaboration among authors is measured by the following formula given by Subramanyam, K (1983).

$$C = \frac{Nm}{Nm + Ns}$$

Where C = Degree of Collaboration.
Nm = Number of multi authored article.
Ns = Number of single authored article.

The degree of collaboration among the Chemistry and Physics departments of this university is presented in table – 4. The highest degree of collaboration is found in Physics department (0.73) followed by Chemistry department (0.70). Multi-authored papers are found highest in Physics articles compare to Chemistry.

Table - 4
Degree of Collaboration of thesis articles in Chemistry and Physics.

Department	**Degree of Collaboration**
Physics	0.73
Chemistry	0.70

Most prolific authors in Chemistry and physics during 1960-2000 (according to 1st author).

The most prolific author were B.N Biswas (Physics) who topped the list with 108 papers followed by G.C Bhar (Physics) with 94 publications, A.K Das (Chemistry) with 82 publications, B.C Sarkar (Physics) with 81 publications and G.S De (Chemistry)with 54 publications. Table – 5 provides a ranked list of authors with their publications. The first authors of the articles produced minimum 10 articles are only taken into consideration for preparing the ranked list. The authors of the Physics department produced more number of articles than Chemistry department.

Table - 5
Author ranking of Chemistry and Physics articles (considering the 1st author only).

Sl. No	Rank No	Author Name	No. of articles	Department
1	1	Biswas, B.N	108	Physics
2	2	Bhar, G.C	94	Physics
3	3	Das, A.K	82	Chemistry
4	4	Sarkar, B.C	81	Physics
5	5	De, G.S	54	Chemistry
6	6	Dutta, R.L	53	Chemistry
7	7	Bagchi, S	35	Chemistry
8	8	Basu, S	31	Chemistry
9	9	Neogy, D	28	Physics
10	10	Samanta, B.C	26	Physics
11	10	Bhattacharya, K	26	Chemistry
12	11	Banerjee, M	25	Chemistry
13	11	Thakur, S	25	Chemistry
14	12	Das, J	24	Chemistry
15	13	Ghosh, B.K	22	Chemistry
16	14	Lahiri, S	21	Chemistry
17	14	Seal, B.K	21	Chemistry
18	14	Misra, T.K	21	Chemistry
19	15	Choudhuri, A.K	18	Chemistry
20	15	Ghosh Majumdar, S	18	Chemistry
21	15	Banerjee, S	18	Physics
22	15	Samanta, L.K	18	Physics
23	16	Bhattachrya, A.J	17	Chemistry
24	16	Basu, A.S	17	Chemistry
25	17	Mukherjee, A	16	Chemistry
26	18	Sinha, C.R	15	Chemistry
27	19	Chatterjee, S.P	13	Chemistry
28	19	Sinha, S	13	Chemistry
29	20	Das, P.K	12	Chemistry
30	20	Rakshit, S.C	12	Chemistry
31	20	Chakraborty, D	12	Chemistry
32	20	Datta, P.K	12	Physics
33	21	Dasgupta, S.S	11	Physics
34	21	Das, D	11	Chemistry
35	21	Chatterjee, A	11	Chemistry
36	21	Sarkar, B	11	Chemistry
37	21	Laskar, S	11	Chemistry
38	21	Ray, S.K	11	Physics
39	22	Ghosh, P	10	Chemistry

Co authorship and credit study for the individual author's in Chemistry and physics.

The co authorship of an author is calculated by taking the number of papers published by the author as first, second, third or more authors. The total credit given for a paper is one. For a

single authored article, the author is given a credit point of one. For a double-authored article, each author is given a credit point of 0.5. For a multi-authored paper, the first author is given a credit point of 0.5 and 0.5 credit point is distributed dividing equally among the other authors. The authors who have credited minimum of 5 points are only taken into consideration for preparing the ranked list. The ranked list of authors according to their credit is shown in Table: 6. The most credited author was A.K Das (Chemistry Department)with 84.7502 points, B.N Biswas (Physics Department)with 74.7241 points, G.C Bhar (Physics Department)with 65.8334 points, and B.C Sarkar (Physics Department)with 62.1668 points. Fig – 2 represents the top 10 credited authors.

According to authorship and credit study for the individual author's in Chemistry and Physics department most credited author was found in the Chemistry department followed by Physics department.

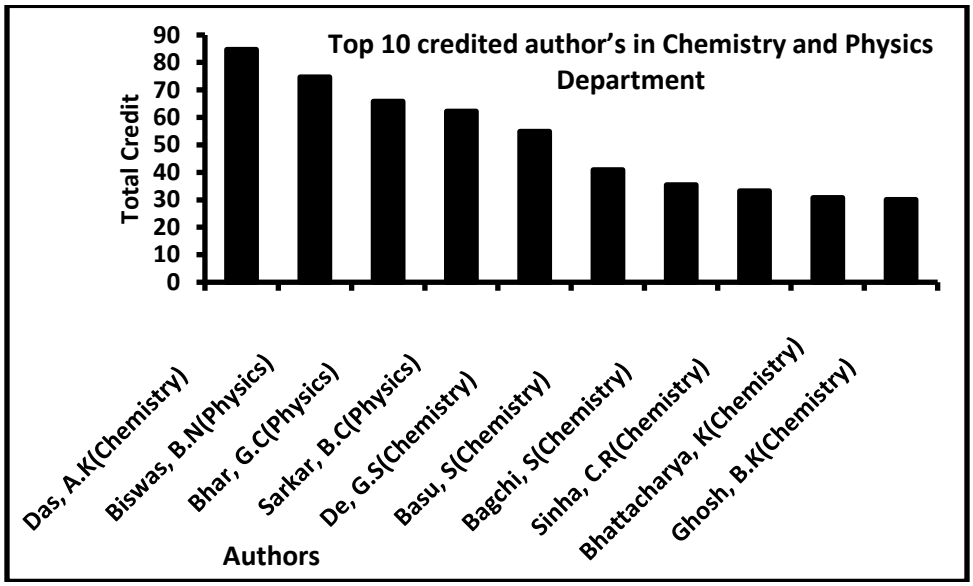
Table - 6

Co authorship and credit study for the individual author's in Chemistry and Physics Department.

Serial No.	Rank No.	Author's Name	Total Credit	Department
1	1	Das, A.K	84.7502	Chemistry
2	2	Biswas, B.N	74.7241	Physics
3	3	Bhar, G.C	65.8334	Physics
4	4	Sarkar, B.C	62.1668	Physics
5	5	De, G.S	54.9167	Chemistry
6	6	Basu, S	40.9167	Chemistry
7	7	Bagchi, S	35.4168	Chemistry
8	8	Sinha, C.R	33.2502	Chemistry
9	9	Bhattacharya, K	30.7500	Chemistry
10	10	Ghosh, B.K	30.0839	Chemistry
11	11	Thakur, S	28.1669	Chemistry
12	12	Dutta, R.L	27.5000	Chemistry
13	13	Banerjee, M	24.9172	Chemistry
14	14	Das, J	24.5834	Chemistry
15	15	Samanta, B.C	21.4167	Physics
16	16	Neogy, D	21.0834	Physics
17	17	Roy, S.K	19.0008	Physics
18	18	Lahiri, S	17.5834	Chemistry
19	19	Banerjee, S	17.4167	Physics
20	20	Seal, B,K	16.0835	Chemistry
21	21	Samanta, L.K	16.0834	Physics
22	22	Mukherjee, A	15.5000	Chemistry
23	23	Bhattacharya, A.J	15.0000	Chemistry
24	24	Misra, T.K	14.4168	Chemistry
25	25	Basu, A.S	13.5000	Chemistry
26	26	GhoshMajumdar, S	13.3335	Chemistry
27	27	Das, P.K	11.6672	Chemistry
28	28	Laskar, S	11.2502	Chemistry
29	29	Mondal, D	10.5841	Physics
30	30	Das, T.K	10.5000	Physics

31	31	Chatterjee, U	10.3338	Physics
32	32	Sinha, S	10.0835	Chemistry
33	33	Das, D	9.7503	Chemistry
34	34	Dasgupta, S.S	9.5834	Physics
35	35	Choudhuri, A.K	9.5000	Chemistry
36	36	Das, S	9.4167	Physics
37	37	Lahiri, P	9.0007	Physics
38	38	Bhattacharya, S.S	8.6667	Chemistry
39	39	Datta, P.K	8.5003	Physics
40	40	Ghosh, P	8.3335	Chemistry
41	41	Chottopadhyay, S	7.9167	Physics
42	42	Chottopadhyay, T.P	7.6667	Physics
43	43	Nandi, M	7.5834	Physics
44	44	Bandyopadhyay, T.K	7.5000	Chemistry
45	45	Sarkar, B	7.5000	Chemistry
46	46	Chakraborty, D	7.0000	Chemistry
47	46	Chatterjee, S.P	7.0000	Chemistry
48	46	Samanta, T	7.0000	Chemistry
49	47	Bhattacharya, A.K	6.8101	Physics
50	48	Rakshit, S.C	6.7500	Chemistry
51	49	Chatterjee, S	6.6670	Physics
52	50	Konar, R.S	6.6669	Chemistry
53	51	Sinhababu, A	6.6668	Chemistry
54	52	Ghosh, S	6.4167	Chemistry
55	53	Mukherjee, A.K	6.2501	Chemistry
56	54	Chatterjee, P	6.0001	Chemistry
57	55	Bhattachrya, G.S	6.0000	Chemistry
58	55	Pal, D	6.0000	Chemistry
59	56	Sen, D	5.9167	Physics
60	57	Dutta, G	5.7500	Physics
61	58	Chatterjee, A	5.7500	Chemistry
62	59	Saha, G	5.7500	Chemistry
63	60	Sarkar, S	5.5836	Physics
64	61	Roy, B.K	5.5002	Chemistry
65	62	Dan, S.R	5.5000	Chemistry
66	63	Neogy, A	5.3334	Physics
67	64	Banerjee, P	5.0001	Physics
68	65	Hati, R	5.0001	Physics
69	66	Das, K.C	5.0000	Physics
70	66	Sen, P.K	5.0000	Physics

Fig. – 2
The top 10 credited authors in Chemistry and Physics Department.



Author's impact in Chemistry and Physics Department (according to 1st author).

The Impact of an author (Table – 7, Fig. - 3) with reference to a journal is calculated by taking the number of papers published by the author (as first author) in the journal multiplied by the average Impact Factor of the journal. The total impact of an author is calculated by summing all such values with reference to that author. The average Impact Factors of the journals are taken as per "SCIENCE JOURNAL RANKING BY AVERAGE IMPACT FACTORS, Version 2002" created by Acad. Prof. Dr. Ioan-Iovitz Popescu Based on ISI annual datasets of SCI-JCR(1974-2000). Popescu Ioan-Iovitz (2002). The authors who have minimum impact of 5 are only taken into consideration for preparing the ranked list.

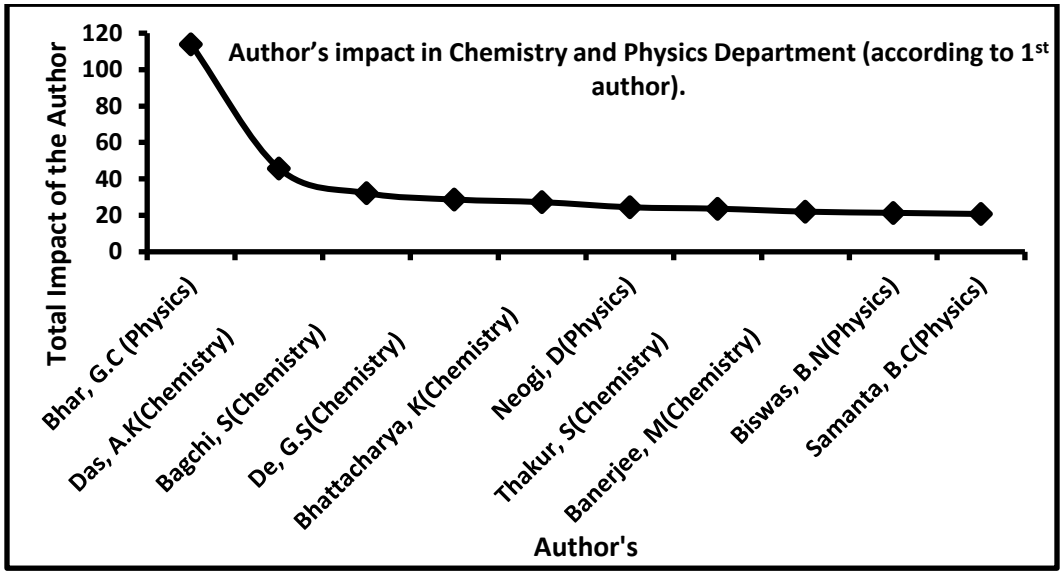
The most credited author was G.C Bhar (Physics Department) who topped the list with 113.87 points, followed by A.K Das (Chemistry Department)with 45.82 points, S Bagchi (Chemistry Department)with 32.20 points, G.S De (Chemistry Department)with 28.68 points, K Bhattacharya (Chemistry Department)with 27.25 points and D Neogi (Physics Department)with 24.44 points. According to Impact of an author study for the individual author's in Chemistry and Physics department, most credited author was found in the Physics department followed by Chemistry department.

Table - 7
Author's impact in Chemistry and Physics Department (according to 1st author).

Sl. No.	Rank No.	Author's Name	Total Impact of the author	Department
1	1	Bhar, G.C	113.87	Physics
2	2	Das, A.K	45.82	Chemistry
3	3	Bagchi, S	32.20	Chemistry

4	4	De, G.S	28.68	Chemistry
5	5	Bhattacharya, K	27.25	Chemistry
6	6	Neogi, D	24.44	Physics
7	7	Thakur, S	23.65	Chemistry
8	8	Banerjee, M	22.03	Chemistry
9	9	Biswas, B.N	21.38	Physics
10	10	Samanta, B.C	20.75	Physics
11	11	Sarkar, B.C	18.97	Physics
12	12	Dutta, R.L	15.38	Chemistry
13	13	Talukdar, S	12.29	Physics
14	14	Misra, T.K	12.05	Chemistry
15	15	Lahiri, S	11.54	Chemistry
16	16	Datta, P.K	11.34	Physics
17	17	Das, J	11.33	Chemistry
18	18	Mukherjee, A	11.23	Chemistry
19	19	Sinha, C.R	10.98	Chemistry
20	20	Basu, S	10.96	Chemistry
21	21	Ghosh, B.K	10.63	Chemistry
22	22	Das, D	10.18	Chemistry
23	23	Ghosh, P	10.11	Chemistry
24	24	Pathak, R.K	9.61	Chemistry
25	25	Sarkar, B	9.00	Chemistry
26	26	Bhattachrya, K	8.19	Chemistry
27	27	Banerjee, S	7.92	Physics
28	28	Das, P.K	7.74	Chemistry
29	29	Samanta, L.K	7.72	Physics
30	30	Banerjee, A.K	7.71	Physics
31	31	Pal, D	7.49	Chemistry
32	32	Bhattacharya, S.S	7.09	Chemistry
33	33	Basu, A.S	6.99	Chemistry
34	34	Chatterjee, S.P	6.87	Chemistry
35	35	Chakraborty, D	6.56	Chemistry
36	36	Mallick, P.K	6.42	Physics
37	37	Bhattacharya, A.J	6.29	Chemistry
38	38	Seal, B.K	6.21	Chemistry
39	39	Sinha, S	5.77	Chemistry
40	40	Ghosh Majumdar, S	5.75	Chemistry
41	41	Dey, J	5.39	Physics
42	42	Chottopadhyay, M.K	5.38	Physics
43	43	Roy, B.K	5.29	Chemistry
44	44	Dutta, K	5.25	Chemistry

Fig. – 3
The top 10 impacted authors.



Author's impact in Chemistry and Physics Department (Considering all Author position).

The total credit given for a paper is one. For a single authored article, the author is given a credit point of one. For a double-authored article each author is given a credit point of 0.5. For a multi-authored paper, the first author is given a credit point of 0.5 and 0.5 credit point is distributed dividing equally among the other authors. The Impact of an author (Table – 8, Fig - 4) with reference to a journal is calculated by taking such credit point of an author multiplied with the average Impact Factor of the journal. The total impact of an author is calculated by summing all such values with reference to that author. The average Impact Factors of the journals are taken as per "SCIENCE JOURNAL RANKING BY AVERAGE IMPACT FACTORS, Version 2002" created by Acad. Prof. Dr. Ioan-Iovitz Popescu Based on ISI annual datasets of SCI-JCR(1974-2000). Popescu Ioan-Iovitz (2002). The authors who have minimum impact of 3 are only taken into consideration for preparing the ranked list.

The most credited author was G.C Bhar (Physics Department) who topped the list with 75.5825 points, followed by K Bhattacharya (Chemistry Department) with 36.6250 points, A.K Das (Chemistry Department)with 35.6500 points, S Bagchi (Chemistry Department)with 24.6650 points, G.S De (Chemistry Department)with 22.6050 points, and B.C Samanta (Physics Department)with 18.8567 points. Fig – 7 represents the top 10 credited authors.

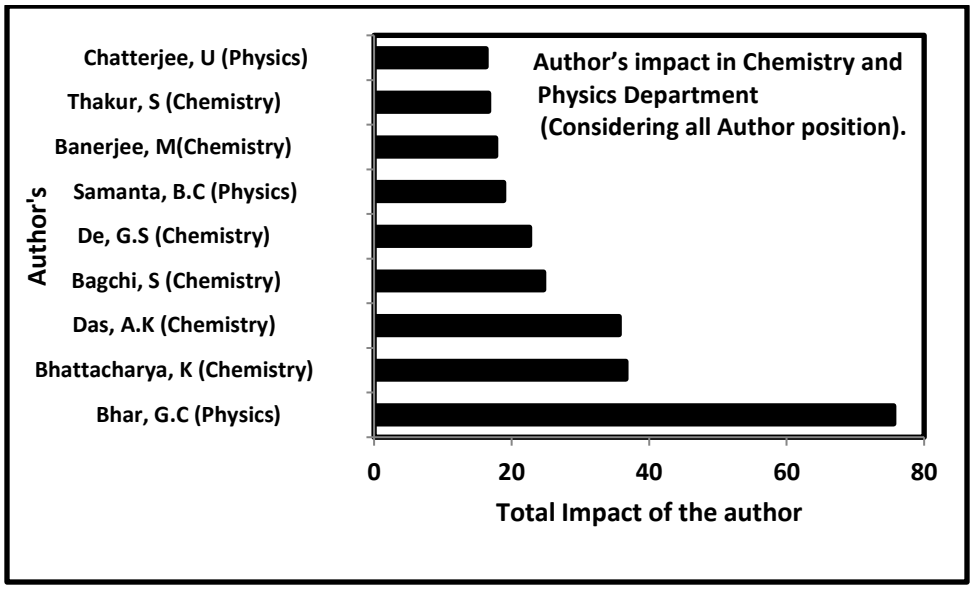
The most credited author was found in the Physics department followed by Chemistry.

Table - 8
Author's impact in Chemistry and Physics Department (Considering all Author position).

Serial No.	Rank No.	Author's Name	Total Impact of the author	Department
1	1	Bhar, G.C	75.5825	Physics
2	2	Bhattacharya, K	36.6250	Chemistry
3	3	Das, A.K	35.6500	Chemistry
5	5	Bagchi, S	24.6650	Chemistry
6	6	De, G.S	22.6050	Chemistry
7	7	Samanta, B.C	18.8567	Physics
8	8	Banerjee, M	17.6850	Chemistry
9	9	Thakur, S	16.6300	Chemistry
10	10	Chatterjee, U	16.2917	Physics
11	11	Neogi, D	15.3975	Physics
12	12	Biswas, B.N	14.6859	Physics
14	14	Sarkar, B.C	13.9383	Physics
15	15	Das, S	13.6152	Physics
16	16	Mukherjee, A	11.2300	Chemistry
17	17	Sinha, C.R	10.9800	Chemistry
20	20	Ghosh, B.K	10.6300	Chemistry
22	22	Basu, S	10.3850	Chemistry
23	23	Datta, P.K	10.2841	Physics
25	25	Banerjee, S	8.9708	Physics
27	27	Lahiri, S	8.7450	Chemistry
30	30	Dutta, R.L	7.8700	Chemistry
31	31	Pal, D	7.4900	Chemistry
33	33	Samanta, L.K	7.1484	Physics
35	35	Talukdar, S	6.1450	Physics
36	36	Misra, T.K	6.0250	Chemistry
37	37	Talukdar, B	5.9742	Physics
39	39	Das, J	5.7550	Chemistry
40	40	Chakraborty, S	5.1725	Physics
41	41	Das, D	5.0900	Chemistry
42	42	Ghosh, P	5.0550	Chemistry
44	44	Pathak, R.K	4.8050	Chemistry
45	45	Dasgupta, S.S	4.7408	Physics
46	46	Banerjee, A.K	4.7350	Physics
47	47	Seal, B.K	4.6400	Chemistry
48	48	Samaddar, S.K	4.5675	Physics
49	49	Sarkar, B	4.5000	Chemistry
50	50	GhoshMajumdar, S	4.4750	Chemistry
51	51	Basu, A.S	4.3600	Chemistry
54	54	Das, T.K	4.1750	Physics
55	55	Rudra, A.M	3.9724	Physics
57	57	Dey, J	3.9392	Physics
58	58	Das, P.K	3.7800	Chemistry
59	59	Mallick, P.K	3.7600	Physics
60	60	Neogi, A	3.7558	Physics

61	61	Ghosh, G	3.6600	Physics
62	62	Bhattacharya, S.S	3.5450	Chemistry
63	63	Chatterjee, S.P	3.4350	Chemistry
65	65	Ray, S.K	3.2959	Physics
66	66	Choudhuri, A.K	3.2300	Chemistry
68	68	Das, K.C	3.1800	Physics
69	69	Bhattachrya, A.J	3.1450	Chemistry

Fig. - 4
Author's impact in Chemistry and Physics Department (Considering all Author position).



The citation scenario of the outstanding authors of Chemistry and Physics Departments.

The citations received by the published articles of pure sciences researchers are collected from Scopus ™. From Table – 9 (Fig- 5), it is evident that B.K Ghosh (Chemistry Department) received highest number of citations (662), with only 239 numbers of self citations whereas C.R Sinha (Chemistry Department) received 526 citations, with 320 self citations during this time period. The other authors, T.K Misra (Chemistry Department) received 385 (with 221 numbers of self citations), A.K Das (Chemistry Department) received 367 (with 115 numbers of self citations) and G.C Bhar (Physics Department) received 292 (with 64 numbers of self citations). The authors who have received minimum 6 numbers of citations are only taken into consideration for preparing the ranked list.

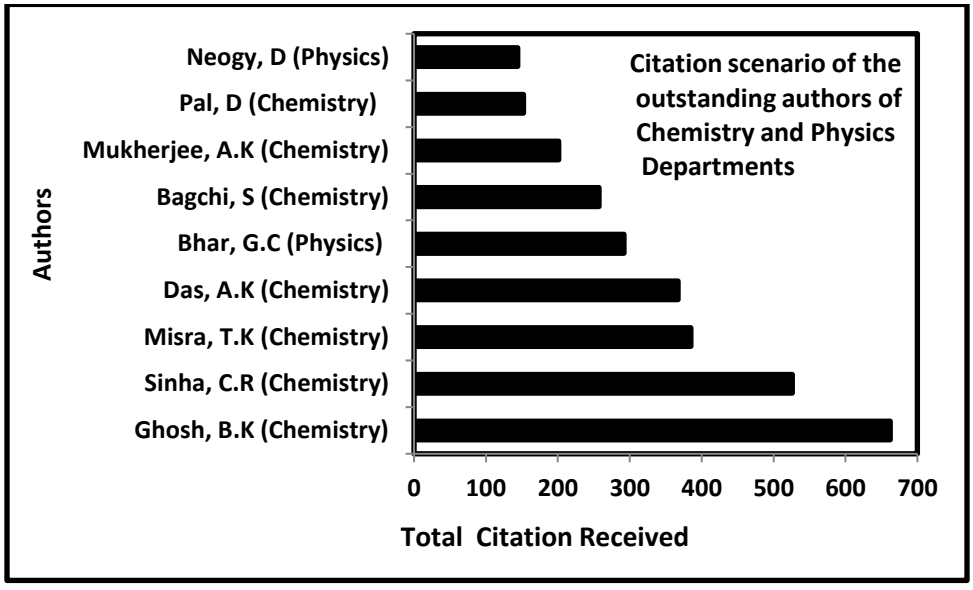
From the study it is found that the authors of the Chemistry department received highest number of citations followed by Physics.

Table - 9
Citation received by the authors of published articles of Chemistry and Physics Departments.

Sl. No	Rank No	Author Name	Total Citation Received	No of Citation from other authors	Self Citation	Department
1	1	Ghosh, B.K	662	423	239	Chemistry
2	2	Sinha, C.R	526	206	320	Chemistry
3	3	Misra, T.K	385	164	221	Chemistry
4	4	Das, A.K	367	252	115	Chemistry
5	5	Bhar, G.C	292	228	64	Physics
6	6	Bagchi, S	257	169	88	Chemistry
8	8	Mukherjee, A.K	201	120	81	Chemistry
9	9	Pal, D	152	93	59	Chemistry
10	10	Neogy, D	144	57	87	Physics
11	11	Dutta, R.L	135	128	7	Chemistry
12	12	Thakur, S	131	121	10	Chemistry
13	13	Chatterjee, P	126	86	40	Chemistry
14	14	Biswas, B.N	112	35	77	Physics
15	15	Lahiri, S	109	39	70	Chemistry
16	16	Samanta, B.C	104	71	33	Physics
18	18	Ghosh, P	88	82	6	Chemistry
19	19	Das, P.K	87	42	45	Chemistry
20	20	Sinha, S	79	32	45	Chemistry
21	20	Samanta, L.K	79	71	8	Physics
23	23	Banerjee, M	67	37	30	Chemistry
24	23	De, G.S	67	31	36	Chemistry
25	25	Laskar, S	66	21	45	Chemistry
26	26	Sarkar, B.C	65	33	32	Physics
27	27	Basu, S	57	40	17	Chemistry
29	29	Basak, B	41	17	24	Chemistry
33	33	Mallick, T.K	35	12	23	Chemistry
36	36	Das, J	25	23	2	Chemistry
37	36	Bag, K	25	11	14	Chemistry
41	41	Laha, A.K	23	23	0	Chemistry
42	42	Seal, B.K	21	10	11	Chemistry
43	42	Sen, H	21	12	9	Physics
44	44	Sinhababu, A	20	6	14	Chemistry
45	45	Nag, J.K	18	11	7	Chemistry
47	47	Sarkar, B	17	11	6	Chemistry
49	49	Ghosal, P.K	14	14	0	Chemistry
50	50	Mallick, P.K	13	13	0	Physics
51	50	Chatterjee, U	13	9	4	Physics
52	52	Pramanik, R	12	10	2	Chemistry
53	52	Pal, S	12	12	0	Chemistry
54	52	Chakraborty, B	12	10	2	Chemistry
55	52	Roy, T	12	6	6	Chemistry
56	56	Biswas, S	11	5	6	Chemistry
57	56	Dutta, J	11	9	2	Chemistry
58	56	Mondal, S.K	11	9	2	Chemistry
60	59	Bhattacharya, K	10	8	2	Chemistry
61	59	Chottopadhyay, T.P	10	8	2	Physics
63	63	Ghosh Majumdar, S	9	7	2	Chemistry

64	63	Lahiri, P	9	7	2	Physics
73	71	Bandyopadhyay, T.K	7	5	2	Chemistry
74	71	Basu, A.S	7	6	1	Chemistry
75	71	Mukherjee, A	7	5	2	Chemistry
76	71	Rakshit, S.C	7	6	1	Chemistry
77	71	Datta, P.K	7	5	2	Physics
78	71	Mondal, D	7	3	4	Physics
80	79	Santra, P.K	6	5	1	Chemistry
81	79	Adhikari, M.S	6	6	0	Chemistry
82	79	Chatterjee, A	6	5	1	Chemistry
83	79	Ghosh, K	6	5	1	Chemistry
88	79	Banerjee, S	6	4	2	Physics
89	79	Ghosh, D.K	6	5	1	Physics
90	79	Chatterjee, A	6	4	2	Physics

Fig. – 5
The citation scenario of the outstanding authors of Chemistry and Physics Departments.



Ranked list of journals preferred for publishing articles by the researchers of Chemistry and Physics Department with their country of origin and average impact factors.

The leading journals preferred by the researchers of Chemistry departments are *Ind Jl Chem* with 185 papers, *Jl Ind Chem Soc* with 138 papers, *Trans Met Chem* with 72 papers and *Ind Jl Pure Appl Phy* with 47 papers by the researchers of Physics department. Table – 10 provides journal preference by the researchers of Chemistry and Physics departments. The journals in which a minimum number of 5 articles are published only taken into consideration for preparing the ranked list.

Table - 10

Ranked list of journals preferred for publishing articles by the researchers of Chemistry and Physics with their country of origin and average impact factors.

Sl. No	Rank No	Journal Name	No. of papers	Department	Country	Average IF of the journal
1	1	Ind Jl Chem	185	Chemistry	India	0.43
2	2	Jl Ind Chem Soc	138	Chemistry	India	0.18
3	3	Trans Met Chem	72	Chemistry	Netherlands	0.81
4	4	Ind Jl Pure Appl Phy	47	Physics	India	0.21
5	5	Polyhedron	25	Chemistry	U.K	
6	5	Ind Jl Phy	25	Physics	India	0.32
7	6	Jl IETE	24	Physics	U.K	
8	7	Fres Anal Chem	20	Chemistry	Germany	1.09
9	8	Proc Ind Acad Sci	19	Chemistry	India	
10	9	Chem Phys Lett	18	Chemistry	Netherlands	2.34
11	10	Jl Chem Soc Far Tran	15	Chemistry	U.S.A	1.71
12	10	Jl Radio Nucl Chem	15	Chemistry	Switzerland	0.69
13	10	Phytochem	15	Chemistry	U.K	1.19
14	11	Elec Let	14	Physics	U.K	1.15
15	11	Phys Rev A	14	Physics	U.K	2.49
16	12	Curr Sci	13	Chemistry	India	0.26
17	12	Appl Phys B	13	Physics	Germany	1.16
18	13	Jl Mol Struc	12	Chemistry	Netherlands	1.07
19	13	Ind Jl Tech	12	Chemistry	India	0.11
20	13	Spectrose Lett	12	Chemistry	U.S.A	0.58
21	13	Appl Radiat Isot	12	Chemistry	U.K	0.59
22	13	Jl Phys D	12	Physics	U.K	1.04
23	14	Spec Acta	11	Chemistry	U.K	0.89
24	14	Bull Chem Soc Jpn	11	Chemistry	Japan	
25	14	Phys Stat Sol A	11	Physics	Germany	0.70
26	14	Appl Phys Lett	11	Physics	U.S.A	3.42
27	14	JEEE Aus	11	Physics	Australia	0.27
28	15	Anal Lett	10	Chemistry	U.S.A	1.09
29	15	Asian Jl Chem	10	Chemistry	India	0.19
30	15	JIETE	10	Physics	U.K	
31	15	Int Jl Elect	10	Physics	U.K	
32	16	Jl Math Phy	9	Physics	U.S.A	1.00
33	17	Analyst	8	Chemistry	U.K	1.15
34	17	Int Jl Quan Chem	8	Chemistry	U.S.A	
35	17	Carbo Res	8	Chemistry	Netherlands	1.42
36	17	Infrared Phys	8	Physics	U.K	0.76
37	18	Jl Inorg Nucl Chem	7	Chemistry	U.S.A	0.89
38	18	Jpn Jl Appl Phy	7	Physics	Japan	
39	18	Opt Comm	7	Physics	France	1.40
40	18	IEEE T Ind Elect	7	Physics	India	0.30
41	18	Int Jl Remote Sen	7	Physics	U.S.A	0.88
42	18	Gen Rel Grav	7	Physics	U.S.A	0.82
43	18	JIETE Ind	7	Physics	India	
44	19	Ind Jl Env Protect	6	Chemistry	India	
45	19	Anal Chem Acta	6	Chemistry	Netherlands	1.67
46	19	Ind Jl Env Health	6	Chemistry	India	

47	19	Jl Soln Chem	6	Chemistry	U.S.A	1.08
48	19	Jl Phys Chem Sol	6	Physics	U.K	1.11
49	19	Proc IACI	6	Physics	India	
50	19	Phys Lett A	6	Physics	Netherlands	1.20
51	19	Jl Chem Phys	6	Physics	U.S.A	3.25
52	19	IEEE Trans MTT	6	Physics	U.S.A	1.02
53	19	IEEE Trans Cir Syst	6	Physics	U.S.A	0.97
54	19	IEEE Jl Quant Elec	6	Physics	U.S.A	2.71
55	20	Jl Chem Res	5	Chemistry	U.K	0.62
56	20	Jl Membrane Sci	5	Chemistry	Netherlands	1.19
57	20	Jl Soil Chem	5	Chemistry	U.S.A	
58	20	Phys Rev A	5	Chemistry	U.K	2.49
59	20	Radiochem Acta	5	Chemistry	Germany	
60	20	Jl Phys Pramana	5	Physics	India	
61	20	Jl Inst Eng	5	Physics	India	
62	20	IEEE Trans Comm	5	Physics	U.S.A	0.85
63	20	Jl Inst Elec Com Eng	5	Physics	Japan	
64	20	Acta Cryst C	5	Physics	Denmark	0.54
65	20	Proc Nat Sci Acad	5	Physics	India	
66	20	IEEE Trans AES	5	Physics	U.S.A	0.47
67	20	Appl Opt	5	Physics	U.S.A	1.39
68	20	Can Jl Phys	5	Physics	Canada	0.76

Country wise distribution of journals preferred for publishing articles by the researchers of Chemistry and Physics Department.

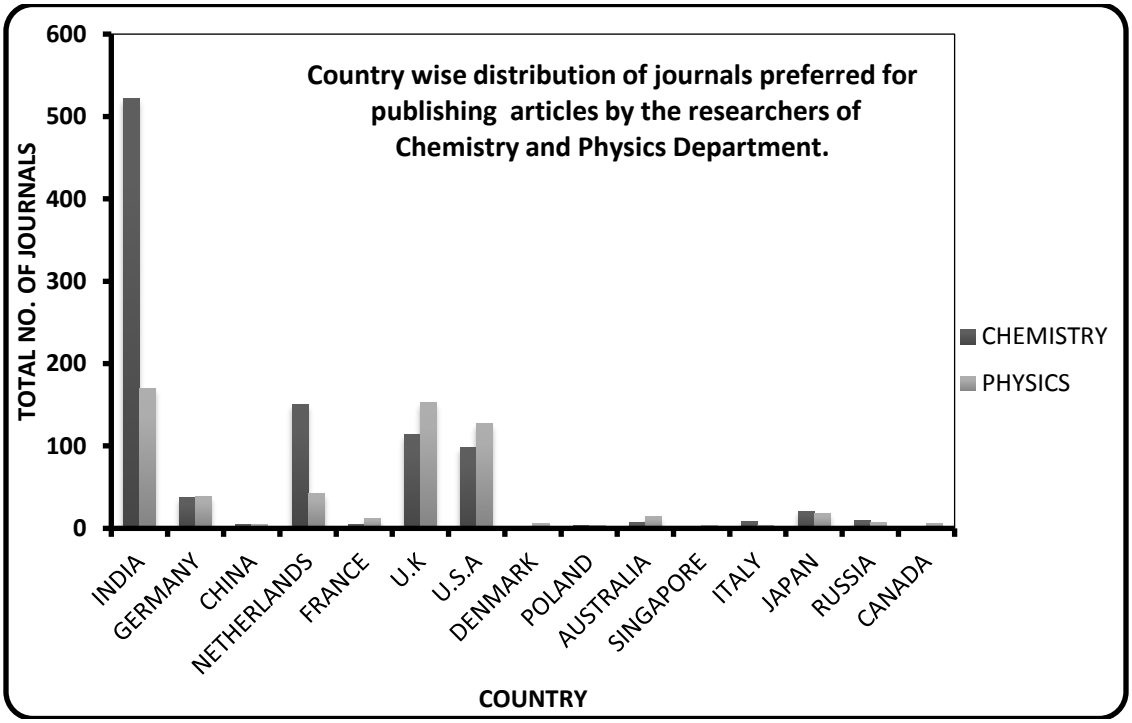
Country wise distribution of journals preferred for publishing articles by the researchers of Chemistry and Physics Departments are presented in Table – 11. Among the top ranking journals publishing the papers are from India with 522(53.31%) publications by the Chemistry Department and 170(27.86%) publications by the Physics Department (Table – 11, Fig. – 6) followed by Netherlands with 150(15.32%) by the Chemistry Department and U.K with 153(25.08%) by the Physics Department. Taking all the papers of the two Departments together 692(43.54%) articles are published in Indian journals and 897 (56.46%) papers are published in foreign journals.

Table - 11
Country wise distribution of journals preferred for publishing articles by the researchers of Chemistry and Physics Department.

Country	Total No. of Journals in Chemistry	Total No. of Journals in Physics	Total No. of Journals
INDIA	522(53.31%)	170(27.86%)	692(43.54%)
GERMANY	37(03.77%)	39(06.39%)	76(04.78%)
CHINA	05(00.51%)	05(00.83%)	10(00.63%)
NETHERLANDS	150(15.32%)	42(06.88%)	192(12.08%)
FRANCE	05(00.51%)	12(01.96%)	17(01.07%)
U.K	114(11.64%)	153(25.08%)	267(19.80%)
U.S.A	98(10.01%)	127(20.81%)	225(14.16%)
DENMARK		06(00.98%)	6(00.37%)
POLAND	03(00.31%)	04(00.66%)	7(00.44%)
AUSTRALIA	07(00.72%)	14(02.29%)	21(01.32%)

SINGAPORE		04(00.66%)	4(00.25%)
ITALY	08(00.82%)	03(00.49%)	11(00.69%)
JAPAN	21(02.14%)	18(02.96%)	39(02.45%)
RUSSIA	09(00.92%)	07(01.16%)	16(01.01%)
CANADA		06(00.98%)	6(00.37%)
	979	610	1589

Fig. – 6
Country wise distribution of journals preferred for publishing articles by the researchers of Chemistry and Physics Department.



Summary and Conclusion

The study gives an insight of research publications of the Chemistry and Physics department of the University of Burdwan. Scientometric analysis of 141 awarded Chemistry theses, 979 published Chemistry thesis articles and 67 awarded Physics theses, 610 published Physics thesis articles by the scholars of The University of Burdwan during 1960-2000 were analyzed to compare the year wise productivity, authorship pattern and collaboration, Co-authorship pattern, Impact of authors, the citation scenario of the outstanding authors and ranked list of journals. The highest number of thesis (30) during 1986-1990 & 1991-1995 and the highest number of thesis articles (283) during 1991-1995 was submitted by the Chemistry Department whereas Physics department submitted highest number of theses (19) and highest number of thesis articles (158) during 1986-1990. The highest degree of collaboration is found in Physics Department (0.73) followed by Chemistry Department (0.70).

Considering the name of the first authors only, the most prolific author were B.N Biswas (Physics) who topped the list with 108 papers followed by G.C Bhar (Physics) with 94 publications, A.K Das (Chemistry) with 82 publications, B.C Sarkar (Physics) with 81 publications and G.S De (Chemistry)with 54 publications. The most credited author (considering fractional credit of authorship at any authorship position)was A.K Das (Chemistry Department) who topped the list with 84.7502 points, followed by B.N Biswas (Physics Department) with 74.7241 points, G.C Bhar (Physics Department) with 65.8334 points, and B.C Sarkar (Physics Department) with 62.1668 points.

The author with highest impact (according to 1st author) was G.C Bhar (Physics Department) who topped the list with 113.87 points, followed by A.K Das (Chemistry Department)with 45.82 points, S Bagchi (Chemistry Department)with 32.20 points, G.S De (Chemistry Department)with 28.68 points, K Bhattacharya (Chemistry Department)with 27.25 points and D Neogi (Physics Department)with 24.44 points.

The author with highest impact (considering all authors at any authorship position with shared credit) was G.C Bhar (Physics Department) who topped the list with 75.5825 points, followed by K Bhattacharya (Chemistry Department) with 36.6250 points. B.K Ghosh (Chemistry Department) received highest number of citations (662), whereas G.C Bhar (Physics Department) received 292 citations during this period. The leading journals preferred by the researchers of Chemistry departments are *Ind Jl Chem* with 185 papers, *Jl Ind Chem Soc* with 138 papers, *Trans Met Chem* with 72 papers and *Ind Jl Pure Appl Phy* with 47 papers by the researchers of Physics department. Taking all the papers of the two Departments together 692(43.54%) articles are published in Indian journals and 897 (56.46%) papers are published in foreign journals.

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